

## CLAIMS

### WHAT IS CLAIMED IS:

1        1. A method for predicting the remaining life of a battery for a vehicle  
2 comprising:  
3                obtaining a value representative of the amount of remaining life for a  
4 battery in a new and fully charged state;  
5                monitoring at least one parameter of the battery during use of the  
6 battery;  
7                obtaining an acceleration factor for the at least one monitored  
8 parameter; and  
9                estimating the amount of life lost from the battery utilizing the  
10 acceleration factor;  
11                whereby the estimation of the amount of life lost utilizes historical  
12 information relating to the use of the battery.

1        2. The method of Claim 1 wherein the at least one parameter includes at  
2 least one of the voltage of the battery, the temperature of the battery, and the state  
3 of charge of the battery.

1        3. The method of Claim 1 wherein the step of monitoring at least one  
2 parameter of the battery includes monitoring the voltage of the battery and the  
3 temperature of the battery.

1        4. The method of Claim 3 wherein the step of estimating the amount of  
2 life lost from the battery comprises determining an amount of time that the battery  
3 has been at a particular voltage and temperature and applying the acceleration  
4 factor to the amount of time to provide an estimate of the amount of life lost during  
5 the amount of time.

1        5. The method of Claim 4 wherein the step of applying the acceleration  
2 factor to the amount of time comprises multiplying the amount of time by the  
3 acceleration factor.

1       6.     The method of Claim 4 wherein the step of monitoring at least one  
2 parameter of the battery further comprises monitoring the state of charge of the  
3 battery.

1       7.     The method of Claim 1 wherein the step of monitoring at least one  
2 parameter of the battery comprises monitoring the state of charge of the battery.

1       8.     The method of Claim 7 wherein the step of estimating the amount of  
2 life lost from the battery comprises determining an amount of time that the battery  
3 has been at a particular state of charge and applying the acceleration factor to the  
4 amount of time to obtain an estimate of the amount of life lost.

1       9.     The method of Claim 8 wherein the step of applying the acceleration  
2 factor to the amount of time comprises dividing the amount of time by the  
3 acceleration factor.

1       10.    The method of Claim 1 further comprising subtracting the estimated  
2 amount of life lost from the battery from the value representative of the amount of  
3 remaining life for a battery in a new and fully charged state to obtain an adjusted  
4 value for the amount of remaining life for the battery.

1       11.    The method of Claim 1 wherein the step of monitoring at least one  
2 parameter comprises monitoring the voltage of the battery, the temperature of the  
3 battery, and the state of charge of the battery.

1       12.    The method of Claim 11 further comprising determining the amount of  
2 time that the battery has been at a particular voltage, temperature, and state of  
3 charge.

1       13.    The method of Claim 12 wherein the step of obtaining an acceleration  
2 factor comprises obtaining a first acceleration factor for the temperature and voltage  
3 and a second acceleration factor for the state of charge.

1        14. The method of Claim 13 wherein the step of estimating the amount of  
2 life lost from the battery comprises applying the first acceleration factor and the  
3 second acceleration factor to the amount of time to obtain an estimated amount of  
4 life lost.

1        15. The method of Claim 14 wherein the step of estimated amount of life  
2 lost from the battery comprises multiplying the amount of time by the first  
3 acceleration factor and dividing the amount of time by the second acceleration factor.

1        16. The method of Claim 1 wherein the step of obtaining an acceleration  
2 factor utilizes a lookup table.

1        17. The method of Claim 1 further comprising providing an output signal  
2 based on the estimated amount of life lost from the battery.

1        18. The method of Claim 17 wherein the output signal is representative of  
2 an amount of life remaining in the battery.

1        19. The method of Claim 17 wherein the output signal comprises a warning  
2 signal.

1        20. A method for monitoring a battery comprising:  
2              obtaining an estimate of the time that a new battery will deliver a  
3 sufficient amount of power for a vehicle application;  
4              monitoring the battery during use;  
5              determining the amount of time that the battery has been in a first state  
6 during the use;  
7              obtaining an acceleration factor for the first state;  
8              adjusting the amount of time that the battery has been in the first state  
9 utilizing the acceleration factor; and  
10             subtracting the adjusted amount of time from the estimate to obtain an  
11 estimate of the remaining time that the battery will deliver a sufficient amount of  
12 power for a vehicle application.

1        21. The method of Claim 20 wherein the first state includes a first  
2 temperature of the battery and a first voltage of the battery.

1        22. The method of Claim 21 wherein the step of adjusting the amount of  
2 time comprises multiplying the amount of time by the acceleration factor.

1        23. The method of Claim 21 wherein the first state also includes a first  
2 state of charge of the battery.

1        24. The method of Claim 23 wherein the step of obtaining an acceleration  
2 factor for the first state comprises obtaining a first acceleration factor for the first  
3 voltage and first temperature and obtaining a second acceleration factor for the first  
4 state of charge.

1        25. The method of Claim 24 wherein the step of adjusting the amount of  
2 time comprises multiplying the amount of time by the first acceleration factor and  
3 dividing the amount of time by the second acceleration factor.

1        26. The method of Claim 20 wherein the step of determining the amount of  
2 time that the battery has been in the first state comprises identifying a plurality of  
3 occurrences of the first state during use of the battery and summing the durations of  
4 time for each of these occurrences.

1        27. The method of Claim 20 further comprising providing an output signal  
2 based on the estimate of the remaining time that the battery will deliver a sufficient  
3 amount of power.

1        28. The method of Claim 20 wherein the step of obtaining an acceleration  
2 factor utilizes a lookup table.

1        29. The method of Claim 20 further comprising:  
2              determining the amount of time that the battery has been in a second  
3 state during the use;  
4              obtaining an acceleration factor for the second state;

5                   adjusting the amount of time that the battery has been in the second  
6 state utilizing the acceleration factor for the second state; and  
7                   subtracting the adjusted amount of time that the battery has been in the  
8 second state from the estimate.

1         30.    A method for monitoring a battery for a vehicle comprising:  
2                   obtaining an input signal representative of an estimate of the amount of  
3 life remaining for a new battery;  
4                   obtaining input signals during use of the battery that are representative  
5 of states of the battery;  
6                   determining the amount of time the battery is at a first state;  
7                   determining the amount of time the battery is at a second state;  
8                   obtaining a first acceleration factor for the first state and a second  
9 acceleration factor for the second state;  
10                  applying the first acceleration factor to the amount of time the battery is  
11 at the first state to provide a first adjusted amount of time;  
12                  applying the second acceleration factor to the amount of time the  
13 battery is at the second state to provide a second adjusted amount of time; and  
14                  subtracting the first adjusted amount of time and the second adjusted  
15 amount of time from the estimate to provide an adjusted estimate of the remaining  
16 life of the battery.

1         31.    The method of Claim 30 wherein the first state and the second state  
2 include at least one of the voltage of the battery and the temperature of the battery.

1         32.    The method of Claim 30 wherein the first state includes a first  
2 temperature of the battery and a first voltage of the battery and the second state  
3 includes a second temperature of the battery and a second voltage of the battery.

1         33.    The method of Claim 32 wherein the step of applying the first  
2 acceleration factor comprises multiplying the first acceleration factor by the amount  
3 of time the battery is in the first state and the step of applying the second  
4 acceleration factor comprises multiplying the second acceleration factor by the  
5 amount of time the battery is in the second state.

1       34. The method of Claim 33 wherein the first state also includes a first  
2 state of charge of the battery and the second state also includes a second state of  
3 charge of the battery.

1       35. The method of Claim 34 wherein the step of obtaining a first  
2 acceleration factor for the first state comprises obtaining a first acceleration factor for  
3 the first voltage and first temperature and obtaining a third acceleration factor for the  
4 first state of charge.

1       36. The method of Claim 35 further comprising applying the third  
2 acceleration factor to the amount of time the battery is at the first state.

1       37. The method of Claim 30 further comprising providing an output signal  
2 based on the adjusted estimate.

1       38. The method of Claim 30 wherein the step of obtaining a first  
2 acceleration factor for the first state and a second acceleration factor for the second  
3 state utilizes a lookup table.